

Spectral mapping of the Galilean Satellites

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The Galilean satellites exhibit greatly diverse surface morphologies and ages, ranging from Io's fresh surface, which is being continuously replenished by volcanic activity, to the heavily cratered ancient surface of Callisto. The geological processes that formed these surfaces, and their modification by radiological processes, can be studied using compositional information about the surfaces and the tenuous atmospheres above them. Data from the Galileo Near Infrared Mapping Spectrometer (NIMS) is being used to identify these materials and to determine their distribution. The NIMS instrument performs spectral mapping in the wavelength range 0.7 to 5.2 micrometers, which contains diagnostic signatures from molecular vibration transitions. Spectral mapping was performed for all four Galilean satellites at spatial resolutions of ~ 5 to 50 km. The innermost of these satellites, Io, shows infrared emission from volcanoes and the presence of sulfur dioxide and possibly iron sulfides. The sulfur dioxide is present over most of the surface and in Io's atmosphere, which is produced by sublimation or direct volcanic venting. The outer three satellites exhibit water ice surfaces with hydrated materials and minor amounts of carbon dioxide, sulfur dioxide, and other compounds. Europa's surface contains the radiolysis products hydrogen peroxide and hydrated sulfuric acid. Other hydrates may be present. Some or all of the sulfur compounds on the icy satellites may arise from ejection, transport, and implantation of material from Io, although internal sources must also be considered. Carbon dioxide, present on the surfaces (and in the Callisto atmosphere) may occur from continual degassing of the interiors.